UNITED NATIONS **A**

General Assembly

Distr.
GENERAL

A/52/561
3 November 1997

ORIGINAL: ENGLISH

Fifty-second session
Agenda item 98 (d)

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT: INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION

Improved effectiveness of early-warning systems with regard to natural and similar disasters

Report of the Secretary-General

SUMMARY

This report, submitted pursuant to General Assembly resolution 50/117 B of 20 December 1995, evaluates the applicability of early-warning concepts for improving preparedness and minimizing risks from natural and similar disasters that have an adverse effect on the environment. It elaborates upon issues first identified in the report of the Secretary-General on early-warning capacities of the United Nations system with regard to natural disasters presented to the fiftieth session of the Assembly (A/50/526) in response to Assembly resolution 49/22 B of 20 December 1994.

Five international expert groups on early warning, convened by the secretariat of the International Decade for Natural Disaster Reduction (IDNDR) in the context of the International Framework for Action, examined scientific knowledge and public practices that could contribute to more accurate and timely short-term forecasting and warning applications for natural and similar disasters. Consideration is given to early-warning measures as they apply to various types of hazards, the use of technology and the importance of local community involvement in determining the efficacy of early-warnings, particularly in developing countries and those with special circumstances that increase their vulnerability to disasters.

The report identifies established and developing capabilities for early warning, and recommends increased local utilization of warnings and related aspects of disaster management in order to minimize the risks of disasters. The recommendations provide a basis for a concrete proposal for an effective international mechanism on early warning under the auspices of the United Nations and as part of the implementation of the IDNDR Framework and the Yokohama Strategy and Plan of Action, which will be submitted by the IDNDR secretariat (see A/52/560).

97-30006 (E) 101197

/...

CONTENTS

	Paragraphs	Page
I. EARLY WARNING OF THE TWENTY-FIRST CENTURY	1 - 12	3
A. Early warning in a changing world	1 - 6	3
B. The international process for improved early warning	7 - 12	4
II. ESSENTIAL FUNCTIONS OF EARLY WARNING	13 - 55	5
A. Early warning and the variable nature of hazards ..	13 - 16	5
B. Early warning for hydrometeorological hazards	17 - 28	5
C. Early warning related to geological hazards	29 - 41	8
D. Early warning for technological hazards and environmental conditions	42 - 55	10
III. TECHNOLOGY DEPENDS ON PEOPLE	56 - 73	13
A. Technological opportunities for improved early warning	56 - 65	13
B. Relevance of local perspectives	66 - 73	14
IV. CONCLUDING OBSERVATIONS	74 - 78	16

I. EARLY WARNING FOR THE TWENTY-FIRST CENTURY

A. Early warning in a changing world

1. Providing early and effective warning of the possible risk of natural or other disasters is widely recognized as crucial to saving lives and protecting property from damage. It is also a key component of effective disaster management.

2. The increased vulnerability of many communities suggests that local practices and the socio-economic conditions threatened by natural hazards need to be studied so that warnings may contribute to the reduction of risks. While natural disasters affect all countries, they have a disproportionately greater impact on developing countries, including countries with emerging economies, those with economies in transition and those with special circumstances, such as small island developing States and land-locked countries.

3. In recent months, there has been evidence of successful warning practices. In Bangladesh earlier this year, more than 500,000 people were evacuated from areas exposed to the most severe effects of a tropical cyclone. This was accomplished through the timely collaboration of scientists, public authorities, local administrators and the full understanding of communities prone to natural disasters. In contrast, floods of unexpected force overwhelmed existing warning or protective measures in countries of North and South America, Central and Western Europe earlier this year.

4. Public authorities can benefit from a better understanding of the importance of early-warnings. The necessity of wise management of the environmental conditions on which societies depend is increasingly apparent as early-warning systems take full account of the relationships among natural hazards, social vulnerability and environmental conditions in local communities.

5. The first report of the Secretary-General on the subject (A/50/526) elaborated upon initiatives and established programmes promoted by the United Nations and its specialized agencies in association with Member States. Present challenges require a more comprehensive approach, and one that takes greater account of private initiatives. New forms of information exchange, commercial interests, and more relevant global experience related to disaster reduction will contribute to improved early-warning practices. Future investments in early-warning systems are required and will be of great benefit in countries most seriously affected by natural and similar disasters.

6. Future advances in early warning will require additional commitments from Member States. Progress in this domain will also open new opportunities for both local community initiatives and commercial involvement. Early warning needs to be reoriented away from largely technical concepts pursued within single sectoral areas of interest. Emphasis must, therefore, be placed on improving the understanding of local needs and on involving those who are most directly affected by natural and related hazards.

B. The international process for improved early warning

7. In 1991, the Scientific and Technical Committee of the International Decade for Natural Disaster Reduction declared early-warning for disaster reduction as one of the Decade's three programme targets. To meet this objective, this Advisory Committee of the Secretary-General has encouraged all countries to ensure ready access to global, regional, national and local warning systems as part of their national development plans by the year 2000.

8. Two additional programme targets were established by the Committee in 1991, namely, the integration of comprehensive national risk assessment with national development plans, and the application of practical mitigation measures that address long-term disaster prevention, preparedness and community awareness at national and local levels. In doing so, essential linkages have been established for institutionalizing effective warnings within national development policies.

9. The critical nature of early-warning in protecting vital resources and in addressing national development objectives was further highlighted at the World Conference on Natural Disaster Reduction held in Yokohama, Japan, in May 1994 (see the report of the Conference, A/CONF.172/9, chap. V). The Conference stressed that, for early-warning to be successful, a commitment in public policy decisions was required. In this respect, pertinent scientific knowledge and a public awareness of early-warning capabilities were recognized as being essential for viable political initiatives. Specific proposed activities were outlined in the primary outcome of the Conference, the Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation containing the Principles, the Strategy and Plan of Action (ibid., chap. I, resolution 1, annex I).

10. The Assembly, in its resolution 50/117 B, requested the Scientific and Technical Committee to undertake a study of ways to improve the effectiveness of early-warning for natural and similar disasters with an adverse impact on the environment. The IDNDR secretariat has continued to work through an inter-agency and multi-disciplinary approach previously used in the development of the International Framework for Action (Assembly resolution 44/236, annex). The secretariat convened five international expert working groups to study aspects of early-warning as they relate to geological hazards, hydrometeorlogical hazards including drought, technological hazards, the use and transfer of modern technology, and national and local capabilities pertinent to early-warning.

11. The conclusions of the expert working groups reflect global experience and form the basis of the present report. Detailed information reports from each working group are available from the IDNDR secretariat. Additional information about early-warning related to wildfire, as well as guiding principles for the effective implementation of national early-warning systems, are also available.

12. The findings of the IDNDR expert groups, the present views conveyed by this report, and those expressed by Member States will become substantive inputs for an international conference on early-warning systems for the reduction of natural disasters, to be held in Potsdam (Germany) in September 1998. This

technical and scientific conference is being sponsored by the Government of Germany with the collaboration of United Nations agencies and international scientific organizations. As a milestone event of the IDNDR Framework for Action, the conference will identify accomplishments and summarize the experience gained in early-warning during the Decade. It will contribute to discussions regarding the most suitable United Nations mechanisms to improve early-warning for natural disasters for the next century.

II. ESSENTIAL FUNCTIONS OF EARLY WARNING

A. Early warning and the variable nature of hazards

13. Successful early-warning depends on translating technical and scientific knowledge into an understandable message that informs a political decision-making process. The existence of operational capacity which can respond to the political call to action is also required. It is vital to concentrate on measures that transfer the warning process closer to locations where people are most vulnerable. At the national level, the crucial starting point must be the political recognition of the need to identify those populations that are most at risk. A second pre-requisite for effective warning is both the understanding by a vulnerable population of the hazards to which it may be exposed and an appreciation of the natural forces that can destroy elements of their economic livelihood and social well-being.

14. The magnitude and scope of hazards can affect the anticipated effectiveness of early-warning practices. The time scale and long-term implications of effects have a distinct bearing on the suitability of forecasting practices as they relate to specific hazards. In addition, an appreciation is required of the linkages between natural events and resulting technological hazards, and conversely, of the impact of human activities on the frequency or severity of the effects of natural hazards.

15. Newly emerging phenomena, such as the possibility of long-term climate change with the expectation of disastrous effects on a global scale or, better known, periodic seasonal or geographical anomalies such as the El Niño Southern Oscillation phenomenon, create further uncertainties and new challenges for institutionalized warning practices.

16. Ultimately, early-warning systems must address the individual hazards that affect people where they live. This needs to be emphasized as hazard patterns change with an increasing frequency of small-scale and physically dispersed hazards influenced by human behaviour and environmental practices that, nonetheless, have significant local impact with cumulative consequences.

B. Early warning for hydrometeorological hazards

17. Hydrometeorological hazards include a wide variety of meteorological, hydrological and climatic phenomena that can pose a threat to life, property or the environment. Warnings are presently issued by one or more national meteorological and hydrological services for over 30 different types of natural

phenomena. As components of global weather, hydrometeorlogical hazards are the most frequent widespread and extensively observed natural hazards.

18. Weather conditions are intimately associated with economic endeavours and social well-being. The violence of extreme anomalous climatic conditions and the destruction caused by single events underlie the importance that must be attached to these conditions. Fortunately, despite their variations in temporal and spatial scales, hydrometeorlogical hazards can be continuously monitored, analysed, predicted and reported upon by a well-established global scientific and technical infrastructure.

19. The national meteorological services in most states and territories are engaged in the daily work of comprehensive data collection, analysis and operational weather forecasting. These national services, working collaboratively in real time, provide the unique operational capabilities of the World Weather Watch of the World Meteorological Organisation (WMO), a coordinated international system of national meteorological and hydrological services that is based on the common acceptance of protocols and standard terminology. It comprises three components: the Global Observing System, which includes a constellation of geostationary and polar orbiting satellites and provides data needed for hazard identification and analysis; the Global Data Processing System, which produces weather analysis, forecasts, and other forms of guidance largely based on numerical model output; and the Global Telecommunication System, which links all the countries of the world and relays observations, forecast guidance and other advisory and information products.

20. This basic institutional infrastructure, in place for more than 30 years, also supports other comprehensive international programmes dedicated to specific hazards and overarching climatic concerns. These include other specific programmes supported by WMO in association with Member States like the World Climate Programme, the Tropical Cyclone Programme, and the Hydrology and Water Resources Programme.

21. Owing to the demonstrated effectiveness of this international system of national capabilities, components of the World Weather Watch have been employed to perform additional early-warning functions associated with other hazards. For example, the Global Telecommunication System has been used to communicate information and warning guidance about volcanic ash clouds in cooperation with the International Civil Aviation Organization (ICAO) and to disseminate tsunami warnings in cooperation with the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO). It also cooperates with the International Atomic Energy Agency in the global communication of information regarding nuclear accidents.

22. As early-warning requirements are considered for the next century, the effects of weather and climate on other hazards need to be increasingly taken into account. The effect of weather conditions on wildfire is well known, and research increasingly provides additional insight into the consequences of fire, smoke and ash on long-term weather patterns. More is now known regarding how natural, chemical or nuclear pollutants are dispersed through air, land and water, often by means of hydrological, meteorological or climatic forces.

23. Drought presents a special challenge for effective early warning owing to its complex and protracted development. Consistent monitoring of vulnerability to drought is required because of its widespread and often devastating effects that strike at the most basic human needs of food, water, shelter and security through incremental deprivation. Effective drought management, as opposed to drought relief, is dependent upon the early identification of risk indicators.

24. The various factors that contribute to drought necessarily involve the coordination of professional disciplines that cut across traditional areas of sectoral responsibility and the mandates of different organizations. Multi-disciplinary monitoring and forecasting programmes currently exist for drought, such as the Global Information and Early-warning System on Food and Agriculture. These existing arrangements demonstrate the feasibility of international and regional agreements to practical institutional arrangements, which could have wider application for the sustained monitoring of continuing natural hazard risks.

25. The integrated global system that has been established for the monitoring and warning of hydrometeorlogical hazards through the coordinated activities of national services is dependent on the free and unrestricted exchange of data and the communication of information. Commercial endeavours or political processes that restrict access to freely available information would be detrimental to the existence of effective warning functions. The commercialization of hydrometeorlogical data or any political restrictions that could limit the availability of information essential to warning systems within individual countries or internationally can only reinforce inequalities based on wealth or political advantage. This would, in turn, increase vulnerability in those very countries of special circumstances where the need for improvement is greatest.

26. Improvements in the accuracy and timeliness of early warning for hydrometeorlogical hazards now rest predominantly on the ability to extend existing practices, material resources and professional capabilities to areas of lesser coverage, concentration or quality in some developing countries. This will involve upgrading observational networks and telecommunication systems in developing countries and among other countries with special considerations.

27. Despite widespread and rapidly evolving means of international transmission, the communication of early warning is still problematic for many of the world's people. Basic telecommunication services remain inadequate in some countries, while in others disaster-resistant forms of communication are required.

28. In cases where improvement in hydrometeorlogical early-warning is required, wider public awareness and education of vulnerable populations assumes critical importance. In order to take account of the full impact of human actions and the growth inherent in communities over time, particular attention is needed to ensure the continuous development of local capabilities embedded in the on-going activities and daily practices within local communities.

C. Early warning related to geological hazards

29. In contrast to many hydrometeorlogical hazards that develop over a matter of hours or days, geological hazards characteristically produce sudden, dramatic and devastating events. They are driven by powerful forces built up over much longer time periods largely beyond the daily sensibilities of the general population. Equally, the complex events that suddenly disclose the apparent geological hazards are often not yet fully understood by even the most sophisticated scientific analysis.

30. Unlike hydrometeorlogical hazards, the probable physical location of most geological hazards, with the exception of tsunamis, are fixed and largely confined to areas that can be broadly identified in advance. Potential risks can be localized in broad terms by parameters of plate tectonics and other aspects of earth science, or in relation to locally distinctive physical characteristics of an area. In many cases, the primary land effects of volcanoes and landslides can be estimated within fixed and identifiable proximities.

31. The most distinguishing factor of geological hazards is that in many cases they strike with little or no advance warning. Much has been learned in recent years about the geological forces that immediately precede some volcanic eruptions, and in optimal conditions some hours notice can be communicated about a potential tsunami occurring over a wide geographical area. Nevertheless, the extreme complexity of the forces that create geological hazards severely limits precise estimates of their physical location or specific times of occurrence. An uncertainty about specific geological events undermines the reliability of any warning. This lack of knowledge that could be translated into practical measures to avoid geological hazards prevents most opportunities for conventional early warning actions.

32. It becomes increasingly important to understand the nature of the effects of geological hazards that can be understood scientifically, so that preliminary protective measures can be taken in areas of known risk. The dissemination of these mitigation practices and the wide public understanding of their value are necessary to fully benefit from early warning.

33. It is important to distinguish the relative feasibility of early warning as it applies in geological terms. A warning is usually a recommendation or instruction for preventive or protective action, such as the evacuation of an area. In contrast, a prediction is a statement that a geological hazard of a specified nature will occur with a given probability during a certain time in a prescribed geographic area. A scientific prediction provides the basis for a warning, issued by government officials.

34. Short-term earthquake prediction depends on the existence, detection, and recognition of anomalous phenomena that are preparatory to the sudden onset of an event. The most comprehensive analysis of potential earthquake precursors has been conducted by the Subcommission on Earthquake Prediction of the International Association for Physics and the Earth's Interior (IASPEI) in 1991 and more recently in 1997.[1] In considering a list of the known possible anomalies and precursors to earthquakes, the IASPEI Subcommission concluded that

there was not a single method of prediction that could be said to be accepted universally and by which earthquakes could be reliably predicted.

35. Regardless of whether short-term earthquake prediction is impossible or, more optimistically, unresolved due to lack of observations, few scientists would claim that it is a proven capability. Most importantly, it must be considered that at the present time there is no short-term earthquake prediction capability with any degree of consistency or reliability. The processes that give rise to earthquake hazards are complex in nature, and there are inherent difficulties that make reliable short-term earthquake prediction a difficult research challenge.

36. While precursors of other geological hazards may permit more opportunity for short-term prediction, the possibilities must be qualified. The Tsunami Warning System operated by the UNESCO Intergovernmental Oceanographic Commission is a well-established and respected warning system that immediately disseminates tsunami warnings throughout the Pacific Basin after the detection of a precursor event.

37. Unlike the field of earthquake prediction, where only a relatively small number of precursors have been observed, volcanology benefits from ample eruption precursors. Yet some potential precursors are so ambiguous that only a vague alert can be sounded, and still others do not culminate in an eruption at all. The largest problem for volcanic prediction is insufficient frequency, spatial concentration, and parameters of observation to distinguish one interpretation from another. Even recent advances in the scientific understanding of these complex events leave much to speculation or, at best, any systematic patterns observed may be highly opportunistic to specific events or individual examples.

38. Given the difficulties of predicting in most instances the occurrence of geological hazards, it is important to understand the effects of these hazards in a specific location in advance. The issuance of advisory instructions should be based upon knowledge of possible consequences of geological hazards. A prediction of possible effects is necessary for developing appropriate preventive measures and for the establishment of response plans.

39. The concept of plate tectonics provides a framework for interpreting the significance of information as it applies to the potential occurrence of geological hazards. Therefore, there is an adequate basis for undertaking further studies and measures in specific locations to avert potential losses. The use of high-resolution, localized information is important for the monitoring of changes that can increase the vulnerability of local communities to the effects and intensity of geological hazards such as earthquakes, landslides, subsidence, or ground collapse.

40. Other means of immediate action as a result of real-time warnings can be employed to prevent the worst effects of geological hazards. High-speed computation and communications systems are able to predict effects as a geological hazard is taking place, and to communicate information about the hazard to locations at risk before the effect has occurred. The potential effects of tsunamis can be notified to communities at risk, and aviation can be

warned of hazards posed by the atmospheric dispersal of invisible volcanic ash clouds. In Japan and in the United States of America, the rapid detection and communication of specific earthquake effects have shut down transportation systems and hazardous industrial processes. It must be noted that these sophisticated technological possibilities demand technical and material resources not readily available in many disaster-prone countries.

41. Numerous scientific bodies and institutions are dedicated to the active study and reporting on geological hazards internationally. However, unlike the international infrastructure that has been developed on the basis of distributed technical abilities and national agencies concerned with hydrometeorology, no comparable institutionalized capability exists at present to address early warning issues and related global concerns for geological hazards. Opportunities should be explored to address early warning of global hazards and disaster events on a more comprehensive basis in which operational synergies could be realized and inter-disciplinary benefits obtained. In this connection, it may be appropriate to reassess, through the United Nations system, the perceived needs and the possible benefits of linking currently fragmented responsibilities related to geological hazards. This could provide increased access to consolidated information and enable the dissemination of more consistent knowledge related to early warning.

D. Early warning for technological hazards and environmental conditions

42. An important outcome of the World Conference on Natural Disaster Reduction was the recognition of the close linkages between disaster losses and environmental degradation, as emphasized in Agenda 21.[2] More specifically, the Conference reaffirmed Principle 18 of the Rio Declaration,[3] which stressed the need for the international community to assist States afflicted by natural disasters and other emergencies that are likely to produce sudden harmful effects to the environment.

43. With these commitments, technological hazards resulting from the spread of economic growth and industrial development have become an additional risk to societies and the environments on which they depend. As the density of industrial activity increases and the probability of incidents rises, the detection and early warning of risks to the environment must become a major responsibility in the improved coordination of early warning practices worldwide. In addition, thought must be given to possible hazards associated with new forms of production. These include activities associated with genetic technology, and the prevalence of other types of biological contamination.

44. Hazardous waste disposal may pose a threat to communities and, in many cases, the risk grows as the identification of socially and economically acceptable solutions becomes more difficult. This is particularly problematic for countries undergoing economic transition and where industrial processes are being upgraded. As many of these risks develop incrementally, and may only emerge after some time, a greater emphasis needs to be placed on monitoring capabilities and the complete life-cycle assessment for products and the manufacturing, use and disposal processes concerned.

45. Adequate safeguards in the use or disposal of hazardous materials are an additional economic burden, particularly for economically disadvantaged societies. Economic inducements encourage the transfer of hazardous materials from sophisticated societies to poorer, less-industrialized countries where adequate warning and protective measures are costly or are not yet fully developed. The disposal of some hazardous material must be rendered safe and monitored for all time. In these cases, early warning capacities must be perpetual.

46. Environment damage can be caused through oversight, insufficient enforcement of controls or standards, or the excessive demands of industrialization impacting upon the provision of basic needs, particularly in urban environments. As hazards themselves result from human behaviour, local knowledge and forewarning can be employed to form the basis of an early warning system. National legislation, technical methods and institutional procedures often exist within countries to address localized events. However, in the context of atmospheric or water-borne contamination, which can lead easily to transboundary effects, there are fewer systematic procedures for early warning of technological hazards. At present, the prevalence of technological hazards and their increased risk to humankind and the environment are insufficiently integrated into existing early warning mechanisms.

47. There are presently at least 20 different United Nations departments, programmes or agencies involved in some manner with technological hazards in an international context. The question must be asked to what extent they are coordinated, compatible and complementary? Most importantly, greater definition is necessary to specify primary responsibilities for defining and implementing global responsibilities for early warning related to technological hazards and environmental risks.

48. Experience has shown that much can be achieved through a coordinated approach. Spurred on by international concern immediately following the Chernobyl disaster, the international Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency[4] provide useful examples of cross-sectoral and transboundary issues being addressed effectively. The coordination provided by the International Atomic Energy Agency and the direction that has resulted in establishing common nomenclature, standard protocols, and agreed reporting procedures have enabled different agencies of the United Nations system to complement each other in operational terms for warning and response activities related to nuclear accidents.

49. Regional initiatives have also seen States that share a risk within a geographical area combine their interests. The Convention on the Transboundary Effects of Industrial Accidents of the Economic Commission for Europe provides for measures regarding the prevention, preparedness and response to industrial accidents capable of causing transboundary effects. Twenty-one States have also acceded to the Open Partial Agreement of the EUR-OPA Major Hazards Agreement with the main aim of closer cooperation in a multi-disciplinary context to ensure better prevention, protection and organization of relief in the event of major natural or technological disasters.

50. There is currently a need for international agreement on designating an authority that would harmonize the many interests involved, and develop global standards for warning and effective response of technological disasters. A joint United Nations Environment Programme (UNEP)/Department of Humanitarian Affairs of the Secretariat Environment Unit was established in the Department in 1994 to enhance and coordinate international response to environmental disasters. More needs to be done to consolidate information about the risks posed by technological hazards and to develop synergies between early warning functions and to integrate them into appropriate prevention strategies.

51. The interplay between the effect of hazards and the achievements of national development, and the extent to which one is able to influence the other, is mirrored in the relationship between technical accomplishment and the maintenance of environmental viability. A similar need for balance and wise management exists in the more widely developed understanding and commitment to careful monitoring of the effects of natural forces on the environment.

52. Wildfire, which is essential for maintaining natural dynamic equilibrium, productivity and the carrying capacity of many ecosystems, can easily destroy important social and economic assets if left uncontrolled. Significantly, absolute prevention policies were pursued for years, until it was recognized that wildfire could never be completely controlled because of practical and financial limitations. Subsequently, the importance of managing wildfire hazards became the dominant policy promoted through the collaborating interests of public authorities, commercial interests and local commitments driven by a combination of balanced economic, social and ecological values.

53. Early detection and warning practices are critical to making decisions necessary for appropriate fire management responses and to maintain balanced natural and human-influenced fire regimes. As wildfire produces conditions to create other potential hazards, such as atmospheric pollution, or increased erosion and siltation, which can lead to flooding, fire management practices constitute an important element related to environmental hazards.

54. Other environmental issues need to be considered when addressing wider early warning concerns. The consequences of weather conditions can either increase or reduce the possibility of severe insect infestation of food supplies on which millions of people depend. Severe erosion, which reduces agricultural production as in parts of Africa or which threatens the existence of cities as in Bangladesh equally demands attention for maintaining early warning systems as an essential part of development programmes.

55. There is a current need to provide more comprehensive attention to the early warning of technological and environmental hazards. Specialized knowledge and various organizational mandates have created gaps or unclear delineations of responsibility in current institutional abilities to address adequately early warning for technological hazards and issues of severe environmental degradation. An existing United Nations authority should be designated to organize global efforts to consolidate information, to sustain focused attention and to coordinate distributed implementation responsibilities.

III. TECHNOLOGY DEPENDS ON PEOPLE

A. Technological opportunities for improved early warning

56. The rapid development of new technology and increased opportunities for its availability in many parts of the world have had a significant effect on improving early warning effectiveness in recent years. Technologies associated with space-based and terrestrial remote sensing, geographic information systems, satellite observation and communications, mathematical modelling of event scenarios, and the entire field of global communications have revolutionized the ability to monitor, analyze and disseminate accurate and timely information about natural hazards.

57. Access to new technology among developing countries has frequently been difficult for technical and economic reasons. Insufficient training in the use of available technologies has hampered their rapid integration into common practice. Capital costs and the recurrent expenditure for maintenance or supporting equipment have also been limiting factors.

58. With respect to other technologies, there are indications that earlier barriers are being diminished as costs are reduced and applications become better understood. As attention is given to developing new technologies relevant for improved early warning, emphasis must equally be given to its practical applications. Sophisticated knowledge or complex procedures need to be translated into useful idioms if they are to provide a benefit to the people most directly affected.

59. Remote sensing technology has proven to be of great use in observing and monitoring the spatial distribution of hazard-related data. The availability and widespread use of remote sensing data have increased enormously as more has become available at continuously reduced cost. Geographic information systems that are able to combine a variety of space and land-based data enable scenarios to be analyzed that would have been impossible only a few years ago.

60. Meteorological satellites now monitor the earth's atmosphere, oceans and land surface almost in real time. If all currently planned commercial and governmental satellites are launched, by the year 2000 numerous satellites will be providing continuous global data. A need will develop, then, to ensure that the wealth of technical data is translated into useful information so that it may be most effectively utilized. It must also be commonly and freely accessible to national early warning systems.

61. Similarly, the benefits of interactive, global telecommunication systems are rapidly becoming evident as commercial interests engage in intense competition to serve predominantly urban areas of countries with well-developed economies. Although the intended area of coverage for some of these systems is global, in practical terms the services are not yet readily available in remote areas or in many developing countries. Commercial system developers are expressing the expectation that, within the next five years, dozens of satellites will provide comprehensive and affordable early warning communication accessible anywhere in the world. The commercial interests propelling these

developments have already demonstrated capabilities that can revolutionize local access to hazard and disaster management information.

62. These imminent developments in telecommunications are encouraging for improved international, as well as local, access to early warning. Global economic trends also suggest that the dissemination function of technical data, public information and authoritative warnings will increasingly rely on commercial enterprises. When coupled with the already demonstrated growth and effectiveness of other forms of electronic communication, a much wider dissemination of warning information will be possible in the early years of the next century.

63. There is a potential risk associated with multiple and varied sources providing warning information, as the public can obtain inaccurate or contradictory information. Official, authenticating authorities, whether of a scientific or political legitimacy, can be more easily bypassed in ways that become detrimental to established emergency procedures. With increased availability of technology, there is an associated need to take into account human factors; local relationships, both institutional as well as interpersonal, must be factored into the warning process.

64. Vulnerability analysis and risk assessment essential for sound early warning practices can only be effective if disaster-prone countries are able to incorporate them into an institutional process that includes community involvement. The human dimension of utilizing technological advances, particularly in the feasibility of application in local community surroundings, is an issue which developmental processes must increasingly embody. A well-focused system, based on an accurate understanding of the need, must reflect the knowledge, technical and human resources available within local communities.

65. Donor governments should be encouraged to include a local component of disaster-resistant communications into telecommunications or similar infrastructure projects that extend basic services to local communities. Within the United Nations, the further development of autonomous basic research and education capabilities at local and national levels, such as that existing within the Office for Outer Space Affairs, should be supported to facilitate adaption of advanced technological methods at the local level. In addition, the business community, in particular, should be viewed as a valuable and virtually untapped resource in this respect.

B. Relevance of local perspectives

66. The foregoing observations reflect increasing scientific knowledge about hazard identification and analysis, coupled with the possibilities for advances in telecommunications and information technology. It is already technically possible to forecast many hazard events and to communicate warnings, often in real time, to national authorities responsible for disaster management in a given country. In many contexts, however, these improvements have not been accompanied by a commensurate increase in the capability of disaster management

agencies and systems to use warning information to reduce risks at the national and local levels.

67. Much of the previous research and application has focused on improvements in hazard monitoring, forecasting and means of dissemination in macro scales of implementation. Unless national and local capabilities for basic early warning functions are improved within individual countries, external enhancements in hazard forecasting and telecommunications will not necessarily lead to successful mitigation practices. This is particularly relevant to the needs of developing countries, small island developing States, countries with economies in transition and others with special circumstances.

68. National disaster management authorities need to develop complementary and integrated sub-systems in order to transform warning information into effective and sustained risk reduction practices. These require organizational structures, information flows and decision-making protocols capable of acting effectively at both national and local levels to monitor and forecast hazards at those levels, and to generate risk scenarios that can indicate the potential impacts of an impending hazard event on specifically identified vulnerable groups and sectors. It is important to develop disaster preparedness strategies that include actions required to reduce losses and expected damage. Equally, the communication of timely information on impending hazard events, potential risk scenarios and preparedness strategies to distinct vulnerable groups and sectors must be expressed in a manner understandable by them so that appropriate mitigating action can be taken.

69. It is important that efforts to focus warning functions at the local level address the actual and full range of hazard types experienced locally, taking full account of patterns and trends in their evolution. Consideration needs to be given to the dynamic nature of the hazards and, equally, to the growth and alteration of local conditions that constitute social and economic measures of vulnerability. Local knowledge related to hazard occurrence, physical conditions of vulnerability and community coping strategies needs to complement other forms of scientific and technical data. The more transparent and inclusive these measures of data collection and utilization are, the more understanding that is created among the people concerned.

70. Experience demonstrates that warnings are more likely to be heeded and acted upon if they occur in association with programmes of public information and on-going education about risks. If vulnerable groups of people are familiar with the risk levels in areas in which they live, there is a greater probability that they have developed their own coping strategies.

71. The design and implementation of public information and education programmes should be an integral part of any comprehensive early warning or disaster management programme. They need to include effective communication strategies, taking account of both the form and the means of conveying the warning information. Above all, they must be relevant to the perceptions and local knowledge of those who receive warnings and are expected to act on them. Programmes must be sustainable over the long term if local early warning capabilities are to be maintained.

72. The overall emphasis of national disaster management agencies and systems must shift thinking from emergency response contingencies towards a better understanding and commitment to the values of risk reduction. Such a change in emphasis depends on national authorities making risk reduction a political priority at the national level and pursuing it with appropriate institutional reforms and necessary investment. The development of institutional capacity for disaster management also needs to be encouraged at the local level, particularly in a commitment to enhance the decision-making processes of vulnerable groups of people.

73. The more decentralized, participatory and risk-oriented a national disaster management system is, the more able it will be to develop, manage and support effective early warning practices. While support and broad direction from national authorities are essential, along with the important linkage to externally-derived information and communication mechanisms, specific functions can best be implemented through local understanding and commitment.

IV. CONCLUDING OBSERVATIONS

74. The objective of early warning is to empower individuals and communities, threatened by natural or similar hazards, to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life and damage to property or fragile environments.

75. Risk assessment provides the basis for an effective warning system at any level of responsibility. It identifies potential threats from hazards and establishes the degree of local exposure or vulnerability to hazardous conditions. This knowledge is essential for policy decisions which translate warning information into effective preventive action.

76. Several groups must contribute to this empowerment. Each has a set of essential overlapping functions for which it should be responsible:

(a) Members of vulnerable populations should be aware of the hazards and the related effects to which they are exposed and be able to take specific actions themselves that will minimize their personal threat of loss or damage;

(b) Local communities should have sufficient familiarity with the hazards to which they are exposed and the understanding of advisory information received to be able to act in a manner to advise, instruct or engage the population in a manner that increases their safety or reduces the possible loss of resources on which the community depends;

(c) National Governments should prepare and issue hazard warnings for their national territory in a timely and effective manner and ensure that warnings and related protective guidance are directed to those populations determined to be most vulnerable to the hazard risk. The provision of support to local communities to utilize information and to develop operational capabilities is an essential function for the translation of early warning knowledge into risk reduction practices;

(d) Regional institutions should provide specialized knowledge, advice or benefit of experience in support of national efforts to develop or to sustain operational capabilities related to hazard risks experienced by countries that share a common geographical environment. Regional organizations are crucial to linking international capabilities to the particular needs of individual countries and in facilitating effective early warning practices among adjacent countries;

(e) International bodies should provide a means for the shared exchange of data and relevant knowledge as a basis for the efficient transfer of advisory information and the technical, material and organizational support necessary to ensure the development and operational capabilities of national authorities or agencies officially designated as responsible for early warning practice.

77. The following recommendations have been developed to advance an effective international mechanism for early warning under the auspices of the United Nations. The following activities, and the concentration of effort which they suggest, should proceed through the implementation of the IDNDR International Framework and the Yokohama Strategy and Plan of Action:

(a) Future energies and resources should be concentrated on the development of operational early warning capabilities within disaster-prone countries. While attention has previously largely been paid to technical applications, there is now a need to concentrate on gaining human understanding and strengthening organizational relationships essential for effective early warning. This applies particularly to developing countries, small island developing States, countries in economic transition, and other countries of special circumstances;

(b) A long-term commitment to public awareness, information programmes and other educational activities that contribute to broad public understanding of locally experienced hazards, potential risks and the feasibility of disaster reduction measures is an essential requirement for effective and sustainable early warning systems;

(c) Early warning systems must be integrated within comprehensive disaster management programmes focused at local community levels. Also, improved coordination is necessary with national authorities and implementing agencies, at all levels;

(d) At the national level, operational early warning capabilities should be developed on the basis of the needs of those local communities assessed as being most exposed to natural hazard risks. A structured hazard assessment that incorporates high-resolution information about local hazards and vulnerabilities is essential for appropriately targeted early warning systems;

(e) Individual countries should undertake an assessment of the effectiveness of their national early warning and related response practices, which should include post-disaster audits of the performance of early warning and resulting actions during actual events. The results of such assessments should become a part of the justification for proposals to support regional or international mechanisms at the conclusion of the Decade;

(f) The international community should agree on guiding principles to assist national governments in their efforts to develop comprehensive and effective early warning systems. These principles should focus on a mutual understanding of essential early warning functions and on the use of common nomenclature, standard protocols and reporting practices;

(g) A consultative forum should be convened by the IDNDR comprising United Nations agencies and departments concerned with early warning to consider future operational early warning responsibilities for all geophysical hazards within the context of coordinated United Nations programmes for social and economic development. Recommendations from this forum should be considered at the Potsdam international early warning conference in September 1998, with a view to their possible inclusion in subsequent proposals for improved coordination of early warning practices made at the conclusion of the Decade;

(h) An assessment should be undertaken of the efficiency and suitability of existing international arrangements and designated organizational responsibilities in early warning for technological hazards and effects associated with environmental conditions. This assessment should be used to incorporate private sector interests and commercial capabilities into collaboration for improved early warning;

(i) Additional research is required to improve understanding of the nature and the effects of hazards. Increased emphasis should also be placed on integrating knowledge and experience derived from research into practical applications at national and local levels;

(j) Development banks and other investors in national economic development programmes should encourage greater emphasis on effective early warning practices as a means of protecting assets. A rationale for these systems should factor in the planning of national development policies, such as those promoted by bilateral development assistance programmes or programmes administered through the United Nations resident coordinator system.

78. Improved early warning for natural and similar disasters with an adverse impact on the environment is no longer predominantly an issue of technological capability. Political commitment is required to apply the knowledge gained by experience and to allocate adequate resources through efficient organizational relationships. These instruments can develop the capacities with and among those people identified as most vulnerable. It is the acceptance of this orientation, in practice, which will provide improved early warning for natural and similar hazards in the twenty-first century.

Notes

[1] IASPEI Subcommission on Earthquake Prediction, 1991, "Evaluation of proposed earthquake precursors", M. Wyss editor: American Geophysical Union, Washington, D.C., p. 94 and IASPEI Subcommission on Earthquake Prediction, 1997, Special issue: earthquake prediction - state of the art, M. Wyss and R. Dmowska editors: Pageoph v. 149, No. 1, p. 264.

[2] Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992, vol. I, Resolutions adopted by the Conference, resolution 1, annex II.

[3] Ibid., annex I.

[4] STI/PUB/765, IAEA, Vienna, 1987.